Все это определило характер исследования как комплексный, с использованием как обычной съемки с фокусировкой по Бреггу-Брентано, так и наклонной съемки, и съемки «скользящим пучком».

Все эксперименты выполнялись на рентгеновском дифрактометре XPert PRO MPD (Panalytical) в CuKα излучении с вертикальным гониометром и быстродействующим твердотельным детектором XCelerator с шириной активной зоны 3,347°. Обработка результатов проводилась с использованием программного обеспечения XPert High Score Plus, а также различных оценочных и аппроксимационных методов анализа микроструктуры.

Показано, что механические свойства покрытий, в частности, микротвердость образцов в большой степени определяется совокупностью таких характеристик как остаточные напряжения, микронапряжения и текстурированность образцов. Изменение преимущественной ориентации кристаллитов происходит в соответствии с принципом минимизации их полной свободной энергии, которая зависит от соотношения вкладов поверхностной энергии, энергии осаждения и энергии упругой деформации [2]. Так же была обнаружена и исследована сильная корреляция механических свойств покрытий, в частности, микротвердости от уровня остаточных напряжений в покрытиях.

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STUDY OF DOMAIN FORMATION BY ION BEAM IN MgO DOPED LITHIUM NIOBATE SINGLE CRYSTALS COVERED BY RESIST

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The formation of ferroelectric domains by focused ion beam irradiation of Z^+ polar surface has been studied in 5mol% MgO doped congruent lithium niobate crystals (MgOLN) covered by resist layer both experimentally and by computer simulation. The obtained results were analyzed and explained in terms of kinetic approach [1].

The irradiation of Z^+ polar surface covered by resist layer was performed by scanning electron-ion microscope (Auriga Crossbeam Workstation, Carl Zeiss) with ion-beam lithography system (Elphy Multibeam, Raith) using dot and stripe exposure regimes. The opposite polar surface was covered by solid Cu electrode and grounded. The domain patterns were revealed by selective chemical etching and visualized by several microscopic methods: optical, atomic force microscopy, scanning electron microscopy, piezoresponse force and confocal Raman microscopies.

The formation of isolated domains by dot exposure has been studied. The dependence of effective domain radius on the charge dose was measured. The dose increase led to increase of the effective domain radius and domain growth through crystal. The domain shape changed from triangle to hexagon and then to circle with dose increase. The shape change was attributed to decrease of the dielectric layer thickness by ion beam milling. The difference of domain shape on opposite surfaces was observed. The fact was attributed to difference of the type of screening charge carriers. Ensembles of nanodomains around domain wall of growing domain were found. Nanodomain formation was explained by correlated nucleation effect due to existence of dielectric layer between the injected charge and the crystal surface [2].

The mathematical model of space charge formation in MgOLN crystal by ion beam with energy of 30 keV has been proposed. The theoretical study showed that the space charge consists essentially of trapped holes and electrons generated by bombarding Ga^+ ions whereas last one recombined with generated electrons. The calculated electric field value was comparable with MgOLN threshold field.

The obtained results allowed us to achieve the minimal period of 2D domain pattern about 800 nm with minimal domain width down to 250 nm and maximal domains depth about 250 µm. The periodic stripe domain structure with period of 2 µm and through domains was created. The structures can be applied for backward second harmonic generation. The results of calculation shown that the period corresponds to 11th synchronism order.

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